

# Hazelnuts in Ontario — Pests

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## Factsheet

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Insect, mite, disease and vertebrate pests cause economic losses to hazelnut production worldwide, though the species and degree of damage vary considerably from place to place. In North America, many of the more damaging pests and diseases are native species that have moved to the introduced European hazelnuts and to North American hybrid hazelnuts in commercial orchards. The most important of these is Eastern filbert blight disease, which poses the biggest threat to the industry.

Mites, aphids, leafhoppers, Japanese beetles, bacterial diseases and various vertebrate pests have also caused problems in recent years. As the hazelnut industry develops, it is likely that other pests will be seen.

At the present time, relatively few pest control products are registered on nut crops in Canada, and pests on hazelnut are managed largely by cultural methods or with resistant varieties, which are still being developed. Because pest control registrations change frequently, specific products are not listed in this Factsheet. For a current list of products registered for use on hazelnuts in Ontario, see OMAFRA Publication 360, *Guide to Fruit Production*, and any supplements posted on the OMAFRA website.

### DISEASES

#### Eastern Filbert Blight

Eastern filbert blight is the most devastating disease of commercial hazelnuts in North America. It is caused by the fungus *Anisogramma anomala* and is native to northeastern North America. Wild American hazelnuts serve as a host for this fungus but are not injured by it. The disease is lethal to commercially important European hazelnuts.

**Biology** – In early spring, the fungus releases spores that are spread by wind-driven rain to developing buds and shoots. The spores germinate, and the fungus penetrates the young tissue and, once inside

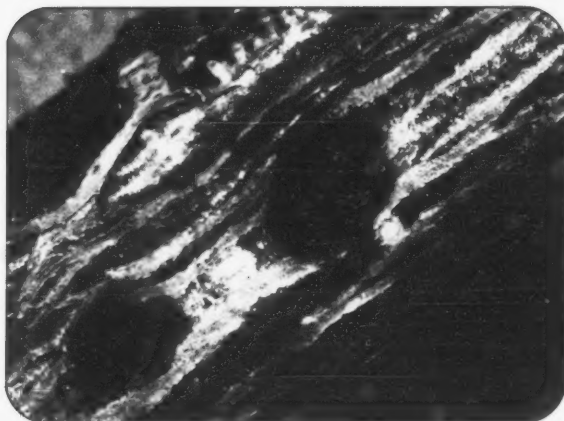
the cells, begins to grow extensively. Following this initial infection, no visible symptoms are present for 12–18 months.

Spore-producing structures, visible as black cankers, are typically formed during the second summer after infection (in some cases, symptoms may not appear until the third summer) and release spores the following spring. The cankers enlarge around branches and twigs each year and can girdle infected branches, killing them. On these dead branches, the leaves die but remain attached — a phenomenon known as flagging. As more branches die, plant vigour and productivity decline, and susceptible varieties die within 5–10 years.

**Identification and Monitoring** – Initial symptoms include rows of raised bumps along affected branches, as the fungal structures expand under the bark, followed by the eruption of white stroma, or cankers, in late spring (Figure 1).



**Figure 1.** The first symptoms of Eastern filbert blight include rows of raised bumps on branches. (Photo courtesy of Joseph O'Brien, USDA Forest Service, bugwood.org).



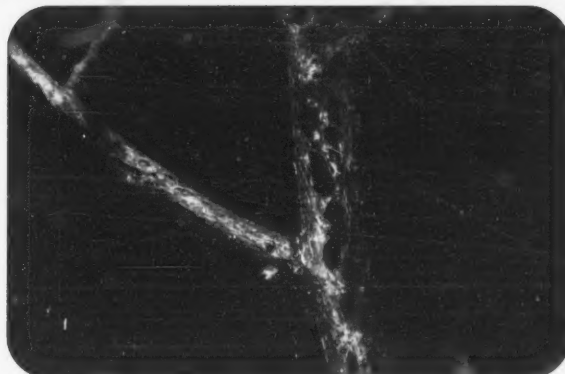
**Figure 2.** Fungal stromata of Eastern filbert blight.

More advanced disease can be identified by the presence of the football-shaped, raised black cankers (Figure 2), which range in size from a few centimetres to almost 1 m in length and run lengthwise in relatively straight rows along infected branches (Figure 3).

Dead branches with leaves still attached also “flag” the presence of the disease. Scout orchards in winter for cankers and in summer, between July and August, for dead (flagging) branches. Check dead branches for cankers.

**Management** – A multi-faceted approach is needed to manage this disease effectively. To do this, scout regularly to detect the disease early, remove diseased material, and use protective sprays and resistant varieties. Prune infected branches immediately. Because the fungus grows ahead of the area in which it produces spores, remove infected plant material 60–90 cm below the edge of the canker. Fungal structures will continue to produce spores after pruning, so burn or bury all pruned material.

Some fungicides are registered for the protection of new growth. See the most recent version of OMAFRA Publication 360, *Guide to Fruit Production*, for products, rates and timing of sprays. While fungicides can help protect new tissue from infection, they are costly. A more cost-effective approach is to use resistant varieties. Research is currently under way to develop new hazelnut varieties that are less susceptible or immune to infection by Eastern filbert blight.



**Figure 3.** Rows of mature black stromata running along the length of branches. (Photo courtesy of Joseph O'Brien, USDA Forest Service, bugwood.org)

### Bacterial Blight

This disease is caused by the bacterium *Xanthomonas arboricola* pv. *corylina* (also called *Xanthomonas campestris* pv. *corylina*). Losses due to this disease are most commonly seen in young, establishing trees less than 6 years of age or in very stressed trees.

**Biology** – The bacteria overwinters in cankers or infected buds, which then ooze from cankers during the growing season.

Bacteria are spread throughout the growing season by rain splash, infected nursery stock or contaminated pruning tools. The bacteria enter trees through natural openings or wounds on buds, leaves, branches or trunks, first infecting the outer bud scales, then moving into the inner bud. Buds may be completely killed or partially damaged. Shoots that emerge from infected buds generally become infected from the bud scales as they grow past them.

Wet, warm weather (>20°C) favours infection. The disease may be more severe in years that follow heavy fall rains, or after a winter where freezing injury has occurred. Infected trees have water-soaked lesions on leaves and stems. Eventually, cankers may develop, sometimes completely encircling infected branches and killing them.

**Identification and Monitoring** – Scout young orchards regularly. Symptoms are most evident in spring as small, angular, reddish-brown spots that are surrounded by a yellow-green circle (Figure 4). Leaf lesions eventually coalesce at the tip of the leaf. Infections on developing nut husks are less common but can appear as dark brown or black spots (Figure 5). Water-soaked lesions may also appear on current-season stems.

Cankers on branches are more difficult to detect but are slightly sunken and reddish-purple with darkened underlying tissue and a sticky liquid oozing from them when humidity is high. Leaves on dead twigs turn brown and cling to the branches (Figure 6).

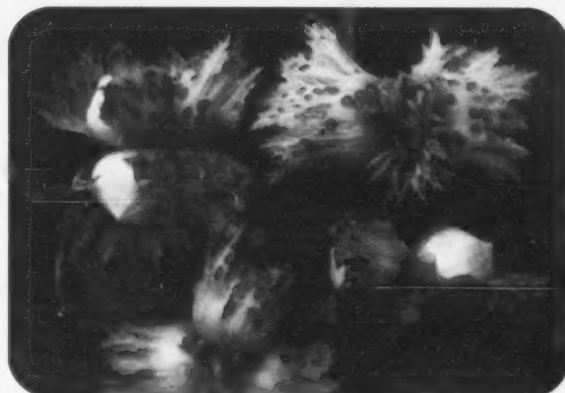
These symptoms can be confused with Eastern filbert blight. Look for lesions on the leaves and the lack of longitudinal rows of black cankers on bark to distinguish the bacterial disease from Eastern filbert blight.

**Management** – Some fungicides are registered against bacterial blight in hazelnut. These can be applied to young orchards in the fall before rains begin. See OMAFRA Publication 360, *Guide to Fruit Production*, for products and rates.

Other strategies to manage this disease are to plant only nursery stock known to be free of the pathogen, and to prune infected branches below cankers in the winter to reduce sources of inoculum. Burn or bury infected material, and sanitize pruning tools after working on each tree.



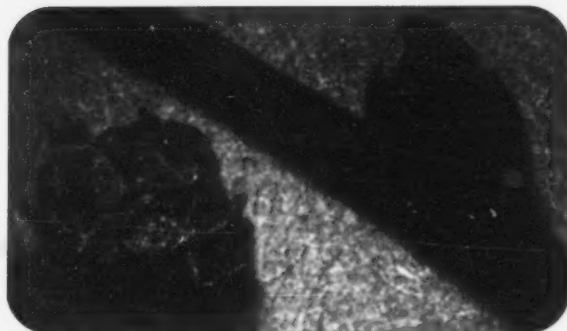
**Figure 4.** Bacterial blight lesions on hazelnut leaf. (Photo courtesy of Marco Scortichini, atlasplantpathogenicbacteria.it)



**Figure 5.** Bacterial blight of hazelnut. (Photo courtesy of Marco Scortichini, atlasplantpathogenicbacteria.it)



**Figure 6.** Dieback of hazelnut leaf due to bacterial blight. (Photo courtesy of L. Gardan, INRA, Angers, bugwood.org)



**Figure 7.** Hazelnut buds infested with bud mites are typically much larger (lower left) than a normal-sized bud (upper right).

## INSECT PESTS

### Mites

Mites are very small relatives of spiders and ticks that feed on the leaves, flower buds and other parts of a wide variety of plants, including hazelnut. While a number of mite species may feed on hazelnut, bud mites are the most common and do the most damage. Bud mites are actually two different species — *Phytoptus avellanae* (the filbert bud mite), which is the more harmful, and *Cecidophyopsis vermiformis*. Both species may be found in the same bud.

**Biology** – Bud mites spend the winter inside dormant flower buds and tend to cause more damage to female buds. In the spring, the mites leave the buds and travel to new, healthy buds. The timing of this migration depends on temperature, with emergence from old buds thought to occur when daytime temperatures are around 15°C. The mites feed and reproduce within the buds throughout the growing season. As mite populations increase, their feeding causes the buds to swell larger than normal size, which is why the mites are sometimes referred to as big bud mites.

Although some buds may swell during the summer, most big bud symptoms are observed late the following winter. Enlarged buds may also deform, dry out and open (called blasted buds). Damaged buds may die in the spring, but often remain fixed to the stem. Buds infested with mites will not produce nuts. Although one species, *P. avellanae*, may have a second form that also feeds on vegetative buds, leaves and male catkins, most bud mites spend the majority of their life cycle protected within the buds, complicating control efforts. Mite damage to hazelnut varies from year to year, ranging from mild injury to complete crop loss.



**Figure 8.** Bud mites within a hazelnut bud. Mites are white, cigar shaped and extremely small.

**Identification and Monitoring** – The easiest way to monitor for mites is to look for enlarged, dried, pea-sized female buds in the fall and the spring (Figure 7).

Mites are difficult to monitor directly, as they are extremely small. Tanglefoot or other sticky materials placed on the twigs on both sides of dry, swollen buds in the spring can help detect them. This will trap mites as they emerge from the buds, and they can be monitored using a 20x hand lens. In winter and early spring, open swollen buds and check for adults with a hand lens. Adult mites are extremely small, white and cigar-shaped (Figure 8). They have four legs and move slowly.

**Management** – There are no products currently registered for the control of bud mites on hazelnut in Ontario. Should products become available in the future, sprays will only be effective if applied in the spring, when mites are migrating from damaged buds to newly forming buds. Once inside the buds, the mites are protected from the chemicals.

Hazelnut susceptibility to bud mite varies with cultivar, with tight-budded types such as 'Barcelona' being less affected, so resistant varieties can be used to reduce the impact of feeding. Predatory mites are also often present in orchards and will feed on bud mites. Practices that preserve populations of beneficial insects, such as minimizing the use of miticides and insecticides, can promote biological control by these beneficial organisms.

Physical removal and burning of infested, enlarged buds during the winter will likely only be practical in very small plantings of hazelnut.





**Figure 9.** Filbert aphids on underside of hazelnut leaf.

### Aphids

Aphids are commonly observed in large numbers on the underside of hazelnut leaves. The filbert aphid, *Myzocallis coryli*, is most commonly observed in Ontario hazelnut, however, other species may also be present.

**Biology** – The filbert aphid overwinters as an egg in crevices on bark and around bud scales. Eggs hatch in the spring, and the young aphids feed on the underside of expanding leaves. Aphids mature rapidly and, when they become adults, the females can immediately produce large numbers of offspring without mating or laying eggs.

Adults and young live together in colonies on the undersides of leaves, with several generations per growing season (Figure 9). Aphid populations can increase quickly under the right environmental conditions, but typically decline in late summer due to high heat and increased activity by natural enemies. In the fall, aphids mate and lay overwintering eggs. Aphid feeding drains fluid and nutrients from leaves, distorting and wilting plants. They also produce a sticky substance, called honeydew, which can promote development of a black sooty mould. Large populations can decrease yield.

**Identification and Monitoring** – Aphids are small, soft-bodied, pear-shaped insects with straw-like mouthparts. They may be winged or wingless. All aphids have two characteristic “tail-pipes,” called cornicles, near the end of their body. Monitor for aphids beginning in mid-spring as temperatures

warm, particularly on the undersides of young, tender leaves. No threshold has been established for aphids on Ontario hazelnut. Small-to-medium populations of aphids can often be controlled by beneficial predators and parasitoids before they can damage the crop; insecticide applications are often not needed.

**Management** – Do not use more nitrogen than needed, as nitrogen stimulates young growth that is attractive to aphids. Numerous natural enemies prey on aphids and can significantly reduce populations. Lady beetles and other predators are often observed feeding on aphids in hazelnut orchards. Aphids are also susceptible to various diseases and tiny parasitic wasps that lay their eggs inside them. The baby wasps kill the aphids as they develop, forming aphid “mummies.” Growers can see mummies in the orchards — look for papery, brown, swollen aphids.

Aphid predators and pathogens can be harmed by many fungicides and insecticides. Use as little pesticide as possible so that populations of these beneficial organisms can develop in hazelnut orchards. Some chemicals are registered for control of aphid populations. See OMAFRA Publication 360, *Guide to Fruit Production*, for products, rates and timing.

### Leafhoppers

Leafhoppers are small, wedge-shaped insects that rapidly run, hop or fly away when they are disturbed. The most common species of leafhopper found on hazelnut in Ontario is the potato leafhopper, *Empoasca fabae*. They can be particularly problematic in new orchards.

**Biology** – Potato leafhoppers do not overwinter in Ontario but are blown in on wind currents from the southern U.S. from mid-May through mid-June. This insect is common in alfalfa and often moves into other crops after hay is cut. In most fruit crops, adults are often first seen after the first hay cut in early to mid-June. Adults mate and lay eggs on leaves and stems, hatching approximately 10 days later. Leafhopper nymphs develop to adulthood in approximately 25 days.

There are multiple generations per year, with activity continuing until the insect is killed by a hard frost. Like aphids, both adult and nymphal leafhoppers are sucking insects that feed on plant

juices within leaves. As they feed, a toxin is injected that blocks the flow of fluids within the plant. Damage typically begins as yellowing and browning at the leaf margin, a phenomenon known as "hopperburn," and leaves often curl under. Leafhopper feeding can also cause stippling or bleaching of leaves. Under hot, dry weather, leafhopper populations can build very rapidly.

**Identification and Monitoring** – Potato leafhopper adults are about 3 mm long, light green and wedge-shaped, with a broad head and body tapering to the tips of the wings, which fold tent-like across the back. They often have six small, pale dots directly behind their head. The nymphs are similar to the adults but are smaller, yellowish-green and lack wings. As the nymphs mature, they develop wingpads. Both adults and nymphs move rapidly away when disturbed, the adults by hopping or flying and the nymphs by running in a distinct sideways fashion.

Check for leafhoppers weekly, beginning in early June. Look for symptoms such as curled leaves or yellowing/browning at the leaf edge. Nymphs and adults will be found mostly on the leaf underside (Figure 10), but they will rapidly move off the leaf during scouting, so turn leaves over carefully when checking for their presence. There are no established thresholds for potato leafhopper in Ontario, however, this insect can cause damage at low populations.

**Management** – There are no insecticides currently registered for control of leafhoppers on hazelnut in Ontario, however, products registered against other pests of hazelnut may have some impact on leafhopper populations. On hazelnut, leafhoppers are generally problematic only on newly planted trees. In some crops, a naturally occurring fungal pathogen can reduce leafhopper populations under cool, moist conditions. Predators and parasitoids are thought to provide only limited control of this insect. If possible, avoid planting hay fields near hazelnut orchards, as leafhoppers commonly move to alternate crops when hay fields are cut.

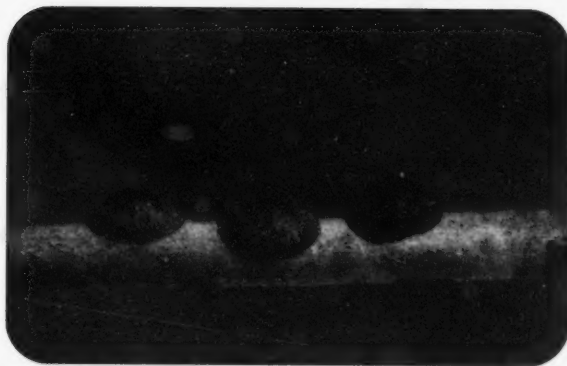


**Figure 10.** Leafhopper adult (upper left) and nymphs on the underside of a bean leaf.

### Scale

Scales are tiny sucking insects that are immobile for most of their lives. They often lack wings or discernable legs and are typically covered by a hard or waxy coating that makes it difficult to distinguish them from the leaves, twigs, branches or trunks on which they live. Numerous species of scale damage tree fruit crops, but the most common scale found on Ontario hazelnuts is the lecanium scale (*Parthenolecanium* spp.). The San Jose scale, *Quadraspidotus perniciosus*, is occasionally observed on hazelnut and other tree nuts.

**Biology** – Female lecanium scales overwinter as nymphs on twigs. They mature to adulthood in early spring and lay eggs under their protective covering; the eggs typically hatch in late June or July. The newly hatched nymphs, often referred to as crawlers because they have legs and are mobile, migrate to the underside of leaf midribs or veins to feed. In late summer, they move back to twigs or other more permanent plant parts, and settle there for the winter. The female scale will affix herself to plant parts, secreting a waxy, protective cover. As the scale moults, the legs and other parts become smaller until it is completely immobile. Like aphids and leafhoppers, scales are sucking insects that drain fluid and nutrients from tree tissues, which can cause dieback of leaves, twigs and branches.



**Figure 11.** Lecanium scales on a hazelnut twig. Note the hard, convex, reddish-brown waxy covering that makes them difficult to recognize as insects. (Photo courtesy of D.K.B. Cheung).

**Identification and Monitoring** – Female lecanium scales are initially flattened but become rounded as they mature. Lecanium scales on hazelnut are typically reddish brown to brown, with a hardened, convex covering that looks somewhat like a door knob (Figure 11). Males are rarely seen. Because the insect is generally immobile and blends well with the host plant, it is often the signs of feeding that are observed, including twig and leaf dieback and the appearance of honeydew, a sticky wet fluid that is excreted by the scale as it feeds. This fluid can attract ants and can lead to the development of a black fungus.

Females of the San Jose scale, which sometimes occurs on hazelnut, are round and located beneath a covering consisting of rings of grey and brown wax, with a raised nipple in the centre. Males of the San Jose scale are observed earlier in the growing season and are small, winged and golden brown.

Where there is a history of damage from scale, monitor throughout the growing season. Look for honeydew, leaf dieback or the presence of scales along twigs or leaf undersurfaces. It may be possible to detect movement of crawlers in late spring or early summer by placing sticky substances such as Tanglefoot or electrical tape in bands on trees. There are no established thresholds for scale on hazelnut in Ontario, but scale populations rarely build to high enough levels on hazelnut to cause significant damage.

**Management** – Scales rarely warrant control on hazelnut, because naturally occurring predators and

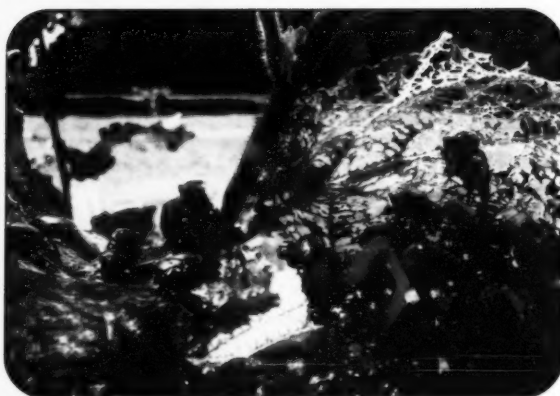
parasites keep populations in check. Minimize the use of broad spectrum insecticides in orchards to help preserve populations of these beneficial natural enemies. Some products are registered for scale control in Ontario hazelnut. See OMAFRA Publication 360, *Guide to Fruit Production*, for products and rates. Timing is very important to the efficacy of scale insecticides, as chemicals will not readily penetrate the protective waxy covering of the immobile stage. Sprays must be targeted against the mobile, “crawler” stage.

### Japanese Beetle

The Japanese beetle, *Popillia japonica* is native to Asia and was first found in Canada in 1939. It is currently found only in eastern North America. The Japanese beetle has not previously been reported as a pest of hazelnut, however, this insect has an extremely wide host range, and adult beetles have done significant damage to foliage in Ontario hazelnut orchards in recent years.

Hazelnut growers who sell and ship hazelnut trees should be aware that Japanese beetles are a quarantine pest regulated by the Canadian Food Inspection Agency (CFIA). This means that the movement of the insect and infested plants or soil is regulated to prevent further spread into uninfested areas. For more information, see the section on Japanese Beetles in OMAFRA Publication 383, *Nursery & Landscape Plant Production and IPM* or see the CFIA Directive D-96-15, *Phytosanitary requirements to prevent the spread of Japanese beetle, Popillia japonica, in Canada and the United States* ([www.inspection.gc.ca](http://www.inspection.gc.ca)).

**Biology** – Japanese beetles spend the winter as larvae, or grubs, in the soil. As temperatures warm in the spring, they begin to feed and grow. The grubs are most commonly found in turf but will feed on the roots of many plants. The larvae pupate in late spring, and adults begin to emerge from the soil in late June. Initially, feeding is confined to low-growing plants, but adults eventually progress to the leaves and fruit of over 300 kinds of plants. Adults remain active for 6–8 weeks, and their numbers peak in late July, after which they lay eggs in the soil of grassy areas. The biology of this insect in hazelnut is not fully understood, but it appears that adults fly in from surrounding areas. Feeding damage appears to be more severe where hazelnut is located close to vineyards or grassy areas, and is most severe on young trees.



**Figure 12.** Japanese beetles infesting young hazelnut tree.

**Identification and Monitoring** – The adults of this species are easily identified. They are approximately 10–12 mm long with a metallic green head, bronze wing covers and white tufts on the tip of the abdomen. They are active in hazelnut plantings from late June through September, when they feed on foliage tissue between veins and leave skeletonized foliage with a lace-like appearance (Figure 12). They often begin feeding at the top of the canopy and progress downwards. The larvae are typical C-shaped white grubs and can be found feeding on roots in the soil in early spring and again in late summer. The grubs may not overwinter in hazelnut orchards but may be present in surrounding grassy areas or turf.

**Management** – There are currently no insecticides registered for control of adult Japanese beetles in hazelnut. If possible, do not locate new orchards near vineyards, turf, grassy areas or other desirable host plants. Clean cultivation or beneficial nematodes may help reduce populations of grubs within orchards. However, this will not stop new adults from invading the orchard from other areas. Mechanical traps that use a sex hormone to attract adult beetles are commercially available and can be used to detect adults when they appear in the spring. However, because these traps actually attract more beetles than they capture, they are not an effective way to control this pest.



**Figure 13.** Obliquebanded leafroller larvae.

### **Leafrollers and Other Spring-Feeding Caterpillars**

The spring-feeding caterpillar complex refers to several members of the moth family (*Lepidoptera*) that feed on fruit trees early in the season, typically from budbreak through the month of June. This includes fruitworms, tent caterpillars, gypsy moths and leafrollers. They generally feed on foliage and cause varying degrees of damage.

**Biology** – Life cycles of the different species vary, but most species overwinter as larvae or eggs, hatching and/or becoming active very early in the spring, when green tissue first appears. The larvae feed on leaves and buds. Leaf-rolling caterpillars will roll leaves up as they expand, using silken webbing, where they hide during the day. Other species, such as tent caterpillars, form silken tents or mats on trees, which they use as shelters.

Most spring-feeding caterpillars pupate in late spring and emerge later as non-feeding adults to mate and lay eggs. Some species overwinter as eggs, but others, notably the obliquebanded leafroller, *Chorisaneyra roseceana*, have a second generation that feeds on leaves and nut clusters in mid- to late summer. In Oregon, the obliquebanded leafroller is a serious pest of hazelnut. Although they have not caused extensive defoliation here, adult obliquebanded leafrollers have been trapped in Ontario hazelnut orchards over the past several years.

**Identification and Monitoring** – Caterpillars of each species are quite variable in appearance:

- Obliquebanded leafroller larvae grow to 20–30 mm and are light to dark to yellowish green with a dark head (Figure 13), while the moths are light tan to dark brown, with darker bands on the wings.



- Fruitworm larvae are large (up to 40 mm long), lime to dark green, with small white spots and longitudinal stripes along the body (Figure 14).
- Tent caterpillars are up to 40–50 mm in length, hairy and brownish or bluish with white stripes or spots running along the back. They live in colonies in silken tents or on silken mats that are spun on trees (Figure 15).
- Gypsy moth larvae are yellow, grey or black with long wispy hairs and pairs of spots running down the back (five blue, then six red) (Figure 16).

Monitor young trees for caterpillars or rolled leaves beginning early in the spring as soon as foliage emerges. Adult obliquebanded leafrollers can be monitored with commercially available traps. No thresholds have been established for leafrollers or other caterpillars in Ontario hazelnuts, however, thresholds established for leafrollers on Ontario apples may be useful as a guide. For thresholds and monitoring methods, see OMAFRA Publication 310, *Integrated Pest Management for Apples*.

**Management** – In many cases, control of spring-feeding caterpillars on hazelnut is not required, because feeding activity is restricted to the early spring, giving trees time to recover. Some products are registered for leafroller control in Ontario hazelnut. Consult OMAFRA Publication 360, *Guide to Fruit Production*, for products and rates. Also, many predatory and parasitic insects and diseases attack caterpillars and may help reduce populations. To conserve populations of these beneficial organisms, apply chemical pest control products only when necessary, and select the most narrow-spectrum products possible.

### Filbertworm

The filbertworm, *Cydia latiferreana*, is the immature stage of a moth and is a very serious pest in most hazelnut-producing regions of the world. Although it has not yet been reported from commercial hazelnut orchards in Ontario, it has been observed in wild acorns from Ontario and Quebec. The larvae feed on the kernels, severely reducing nut quality and marketable yield. Adults of this insect can be monitored with commercially available pheromone traps. These may have to be used in orchards located close to wild hazelnut or oak. There are no insecticides registered for use against this insect in Canada.



Figure 14. Fruitworm larvae.



Figure 15. Eastern tent caterpillar colonies construct silken tents on branches, which they use as a shelter.



Figure 16. Gypsy moth larvae.

## **VERTEBRATES**

Many animal species will feed on hazelnuts. Blue jays and squirrels are particularly fond of hazelnuts and may remove much of the crop before it is mature.

### **Birds**

Blue jays and crows feed on ripening nuts. Flocks will congregate in hazelnut orchards and can have a substantial impact on yield. Wild turkeys will also feed on nuts in the fall and buds during the winter months. Possible methods of controlling birds in orchards include physical exclusion, visual repellants and acoustic repellants.

Physical exclusion uses netting or other barriers to physically prevent birds from feeding on the crop. While effective, it can be costly and impractical.

Visual repellants, including scare-eye balloons, streamers, flashtape, flashing lights, mirrors and silhouettes, mimic the eyes, mouths or movement of birds of prey.

Acoustic repellants use various types of sounds to frighten birds away. Propane-fired bird scaring cannons, which produce loud, gunfire-like sounds, are probably the most familiar, but lead to frequent noise complaints from neighbours. Additionally, in hazelnut, propane cannons have not been effective against blue jays. Other types of electronic equipment, which mimic the distress or predator attack calls of various bird species, are available and can be effective.

Many growers ask whether they can hunt to control bird and other vertebrate pests. Although sometimes possible, hunting is generally not as effective as the previously listed techniques. Growers should also be aware there may be legislation governing hunting and the use of firearms on their property. Laws protect many bird species, so always check with the Ministry of Natural Resources before you allow anyone to hunt on your property. For further information on hunting problem birds in Ontario orchards, contact the Ontario Ministry of Natural Resources.

As a general rule, multiple methods will be required to manage problem bird populations in orchards, and these should be initiated early. Vary the timing, placement and type of device throughout the season to avoid acclimation of birds to the repellant. For more information, see the OMAFRA Factsheet *Bird Control on Grape and Tender Fruit Farms*, Order No. 98-035.

## **Mammals**

### **Deer**

Deer will feed on the foliage, buds or nuts of many commercially cultivated trees, including hazelnut, and this can impact growth and yield. Bucks will also rub antlers against tree trunks, damaging bark. Several types of fences are available for use around orchards, including permanent woven wire, mesh and electrical fences. These may be most economical for orchards in areas with large populations of deer where the likelihood of damage is high.

Auditory and visual repellants (propane cannons, strobe lights, sirens, etc.) can be effective in scaring deer off when they first appear, however deer generally become accustomed to them over the long term. Dogs contained in the orchard using invisible electric fencing are sometimes used to chase deer away. Odour or taste repellents are also available to manage deer in orchards. Contact repellents are applied directly to plants and repel deer by imparting an unpleasant taste. The more commonly used area repellents are applied near the plants and rely on odour to repel deer. Some nut growers have found hanging bar soaps from trees around orchards to be helpful in deterring deer.

Finally, problem deer can be hunted by licensed hunters during hunting season or by obtaining a permit for agricultural deer removal. As with birds, hunting is regulated by the Ministry of Natural Resources, and growers are responsible for obtaining all necessary permits and ensuring that all relevant regulations are complied with.

### **Raccoons**

Raccoons can also be a significant problem in hazelnut orchards and can remove maturing nuts from several acres of trees before harvest. They may also break the branches when climbing trees to feed on nuts. There are no poisonous bait formulations registered against raccoons. Some growers of vegetables and other crops have found electric fences to be effective in deterring raccoons. These should be at least two-wire fences, with wires spaced 15 and 30 cm above the ground, although a three-wire fence, with wires spaced 10, 20 and 33 cm above the ground, may provide better protection. Raccoons may also be hunted with an appropriate permit. Contact the Ministry of Natural Resources for more information on hunting requirements for raccoons in Ontario.

## Rodents

Squirrels, mice, voles and other rodents feed on nuts, roots and tree bark near the ground. Squirrels, like blue jays, are fond of hazelnuts. They eat ripening nuts and carry mature nuts away. Mice and voles are often only a problem when populations are very high, as populations are often kept in check by their many natural predators. Regularly mow grasses in and around orchards to 8–15 cm. This is typically done in hazelnut plantings to facilitate harvest and will help to remove cover needed by voles to breed and hide from predators. However, avoid mowing techniques (e.g., sickle bar mowers) that leave a thatch layer.

Remove all mulch, sod, nuts and other debris at least 60 cm from the base of trunks or tree rows.

Mouse guards can be used to protect the bark of newly planted trees from vole damage. These should be buried 5 cm deep in the soil, and require regular monitoring to ensure they are working and not interfering with root or bark development.

Where cultural practices are insufficient, toxic baits are available for use against mice in orchards. See OMAFRA Publication 360, *Guide to Fruit Production*, for a list of baits registered for use in orchards. Always check the label to ensure the product can be legally used in your crop. Baits are not registered for use against squirrels or raccoons. Squirrels may be managed with traps or through hunting, however, growers and landowners are responsible for ensuring all relevant legislation is followed. Contact the Ontario Ministry of Natural Resources for more information.

## RESOURCES

The websites listed here may reference pest control products that are not registered in Ontario. For a listing of pest control products registered on hazelnuts in Ontario, see OMAFRA Publication 360, *Guide to Fruit Production*, or an OMAFRA specialist.

[www.ontario.ca/crops](http://www.ontario.ca/crops)

In the Horticulture section, see Agroforestry.

[www.songonline.ca](http://www.songonline.ca)

[www.songonline.ca/ecsong](http://www.songonline.ca/ecsong)

[www.oregonhazelnuts.org/index.php](http://www.oregonhazelnuts.org/index.php)

[www.nutfruit.org](http://www.nutfruit.org)

[www.hazelnutcouncil.org/about/council.cfm](http://www.hazelnutcouncil.org/about/council.cfm)

[www.nuthealth.org](http://www.nuthealth.org)

[www.hazelnut.com](http://www.hazelnut.com)

[www.canadianchestnutcouncil.org](http://www.canadianchestnutcouncil.org)

[www.wfghazelnuts.com](http://www.wfghazelnuts.com)

[www.nutgrowing.org](http://www.nutgrowing.org)

OSU Eastern Filbert Blight Help Page:

[www.oregonstate.edu/dept/botany/epp/EFB/index.htm](http://www.oregonstate.edu/dept/botany/epp/EFB/index.htm)

## OMAFRA Factsheets:

12-007 *Hazelnuts in Ontario – Biology and Potential Varieties*

12-011 *Hazelnuts in Ontario – Growing, Harvesting and Food Safety*

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